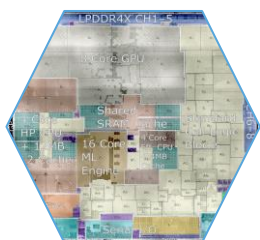


## Apple M1 System-on-Chip

*A deep-dive analysis of Apple's first in-house CPU for Mac.*



Two new Apple MacBook models and the Mac mini are now powered by an Apple in-house System-on-Chip (SoC) design: the M1. The transition from Intel x86 processors has created shockwaves felt throughout the processor and computing world. This new, first SoC for Mac features 4-CPU high-performance cores, 4-CPU high-efficiency cores, and 8-GPU cores. The tight software-hardware integration inside Apple enabled a compact, efficient processor for personal computer that outcompetes many premium microprocessors. 16 billion transistors using TSMC 5nm process were used to build it.

To reveal all the details of this new, exceptional SoC, this report features multiple analyses: a floor plan analysis to understand the high-level chip architecture with IP block area contribution measurements, a front-end construction analysis that reveals the most interesting features of the new TSMC 5nm process, a back-end construction analysis of the packaging structure, and a detailed manufacturing cost analysis.

On the SoC side, it appears that the die area of the M1 was optimized for functionality rather than SRAM cache. There is limited on-chip cache, taking cues from mobile SoC designs relying on the universal memory architecture (UMA) concept and external LPDDR4X DRAM.

Significant die area is devoted to standard cell functions, indicating that Apple is leveraging in-house chip design to optimize hardware for the operating system.

On the packaging side, the same structure is used for Apple's A12X and A12Z, with the integration of the DRAM on the SoC substrate, and embedded silicon capacitors in the substrate.

Along with a complete construction analysis using SEM cross-sections, materials analyses, and delayering, the front-end analysis employs a high-resolution TEM cross-section to expose the high mobility channel of the 5nm process, and the back-end analysis uses CT-Scan (3D X-ray) to reveal the layout structure of the package.

**Title:** Apple M1 SoC

**Pages:** 120

**Date:** Dec. 2020

**Delivery:**

- The floor plan: already available

- The complete analysis: end of December 2020

**Format:**

PDF & Excel file

**Price:** EUR 6,490

**Reference:** SP20608

### COMPLETE TEARDOWN WITH

- Detailed photos
- Floor plan analysis
- Precise measurements
- Materials analysis
- Front-end structural analysis with TEM
- Back-end structural analysis with CT-Scan
- Supply-chain evaluation
- Manufacturing cost analysis

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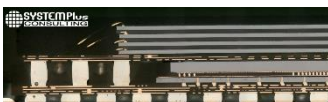


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## RELATED REPORTS



**Intel Foveros 3D Packaging Technology**  
*Intel Core i5-L16G7: the first utilisation of Intel's Foveros Technology with Package-on-Package configuration in a consumer product.*  
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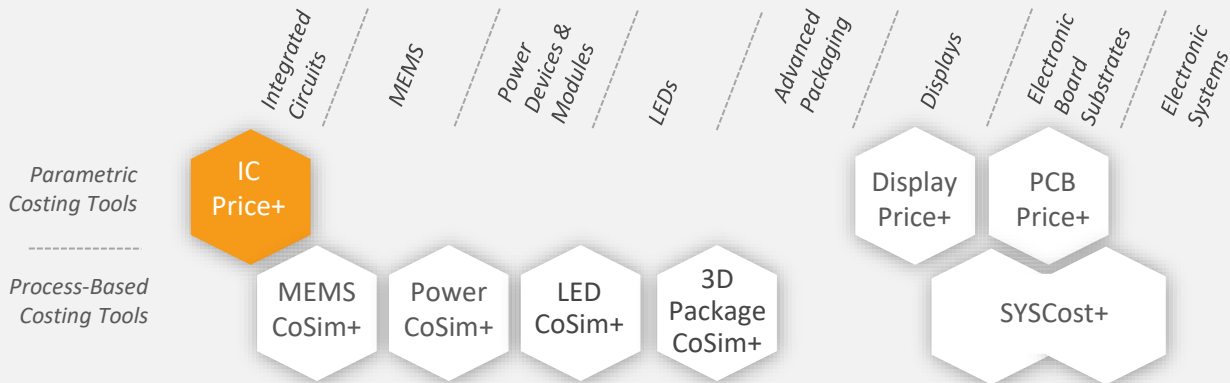


**Advanced System-in-Package Technology in Apple's AirPods Pro**  
*Analysis of Apple's first SiP found in the latest AirPods, featuring a fully integrated SiP for audio codec and Bluetooth connectivity.*  
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**Nvidia Tegra K1 Visual Computing Module**  
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Our analysis is performed with our costing tool IC Price+.

System Plus Consulting offers powerful costing tools to evaluate the production cost and selling price from single chip to complex structures.

### IC Price+

The tool performs the necessary cost simulation of any Integrated Circuit: ASICs, microcontrollers, memories, DSP, smartpower...

## ABOUT SYSTEM PLUS CONSULTING

### WHAT IS A REVERSE COSTING®?

Reverse Costing® is the process of disassembling a device (or a system) in order to identify its technology and calculate its manufacturing cost, using in-house models and tools.



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## 1. INTRODUCTION

The present terms and conditions apply to the offers, sales and deliveries of services managed by System Plus Consulting except in the case of a particular written agreement.

Buyer must note that placing an order means an agreement without any restriction with these terms and conditions.

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Prices of the purchased services are those which are in force on the date the order is placed. Prices are in Euros and worked out without taxes. Consequently, the taxes and possible added costs agreed when the order is placed will be charged on these initial prices.

System Plus Consulting may change its prices whenever the company thinks it necessary. However, the company commits itself in invoicing at the prices in force on the date the order is placed.

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The quoted prices already include the rebates and discounts that System Plus Consulting could have granted according to the number of orders placed by the Buyer, or other specific conditions. No discount is granted in case of early payment.

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System Plus Consulting delivered services are to be paid within 30 days end of month by bank transfer except in the case of a particular written agreement.

If the payment does not reach System Plus Consulting on the deadline, the Buyer has to pay System Plus Consulting a penalty for late payment the amount of which is three times the legal interest rate. The legal interest rate is the current one on the delivery date. This penalty is worked out on the unpaid invoice amount, starting from the invoice deadline. This penalty is sent without previous notice.

When payment terms are over 30 days end of month, the Buyer has to pay a deposit which amount is 10% of the total invoice amount when placing his order.

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System Plus Consulting remains sole owner of the delivered services until total payment of the invoice.

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System Plus Consulting responsibility will not be involved in non execution or late delivery of one of its duties described in the current terms and conditions if these are the result of a force majeure case. Therefore, the force majeure includes all external event unpredictable and irresistible as defined by the article 1148 of the French Code Civil?

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